

# Model Name: P460HVN01.2

Issue Date: 2013/04/30

( ) Preliminary Specifications  
( \* ) Final Specifications

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## Record of Revision

[illegible]

# 1. General Description

This specification applies to the 46.0 inch Color TFT-LCD Module P460HVN01.2. This LCD module has a TFT active matrix type liquid crystal panel 1,920x1,080 pixels, and diagonal size of 46.0 inch. This module supports 1,920x1080 mode. Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 10-bit gray scale signal for each dot.

The P460HVN01.2 has been designed to apply the 10-bit 2 channel LVDS interface method. The main feature of P460HVN01.2 would be high brightness, high contrast, wide viewing angle, high color saturation, super narrow bezel, and direct LED backlight

## \* General Information

Items	Specification	Unit	Note
Active Screen Size	46.0	Inch	
Display Area	1018.08(H) x 572.67(V)	mm	
Outline Dimension	1023.68(H) x 578.27(V) x 37.5(D)	mm	1
Driver Element	a-Si TFT active matrix		
Display Colors	10 bit (8bit+FRC), 1073.7M	Colors	
Number of Pixels	1,920x1080	Pixel	
Pixel Pitch	0.53025 (H) x 0.53025(W)	mm	
Pixel Arrangement	RGB vertical stripe		
Display Operation Mode	Normally Black		
Display Orientation	Landscape/Portrait Enable		
Surface Treatment	AG		Haze = 11%

Note:

(1)  $D_{\max}$ : 54.2mm (Front bezel to Driver cover);  $D_{\min}$ : 37.5mm (Front bezel to Bezel back)

## 2. Absolute Maximum Ratings

The followings are maximum values which, if exceeded, may cause faulty operation or damage to the unit

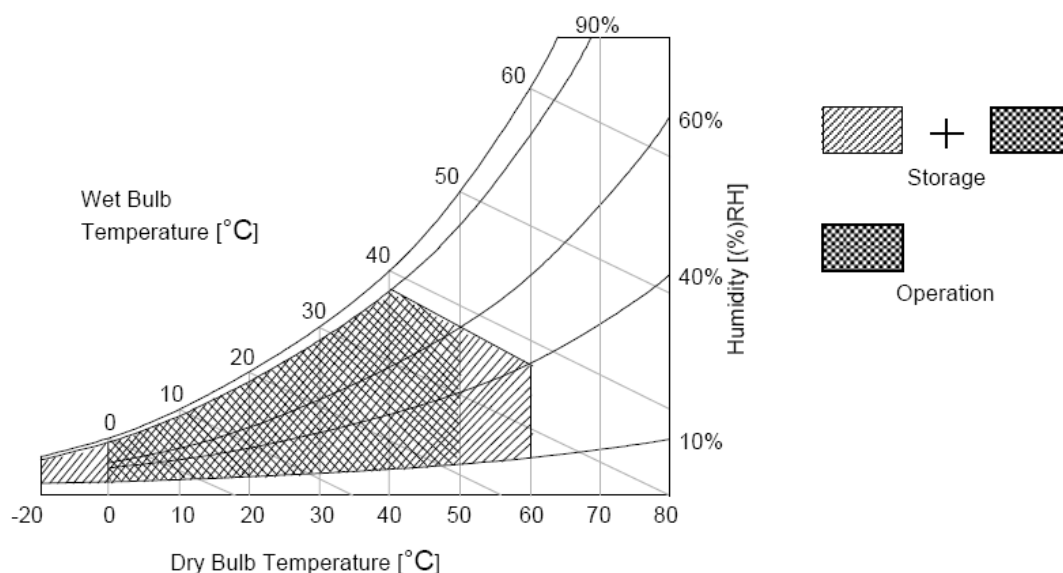
Item	Symbol	Min	Max	Unit	Conditions
Logic/LCD Drive Voltage	Vcc	-0.3	14	[Volt]	Note 1
Input Voltage of Signal	Vin	-0.3	4	[Volt]	Note 1
Operating Temperature	TOP	0	+50	[°C]	Note 2
Operating Humidity	HOP	10	90	[%RH]	Note 2
Storage Temperature	TST	-20	+60	[°C]	Note 2
Storage Humidity	HST	10	90	[%RH]	Note 2
Panel Surface Temperature	PST		65	[°C]	Note 3

Note 1: Duration:50 msec.

Note 2 : Maximum Wet-Bulb should be 39°C and No condensation.

The relative humidity must not exceed 90% non-condensing at temperatures of 40°C or less. At temperatures greater than 40°C, the wet bulb temperature must not exceed 39°C.

Note 3: Surface temperature is measured at 50°C Dry condition



## 3. Electrical Specification

The P460HVN01.2 requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second is employed for LED driver.

### 3.1.1 Electrical Characteristics

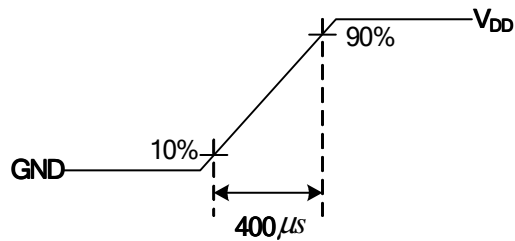
Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max		
LCD							
Power Supply Input Voltage		$V_{DD}$	10.8	12	13.2	$V_{DC}$	
Power Supply Input Current		$I_{DD}$	--	0.9	1.08	A	1
Power Consumption		$P_C$	--	10.8	12.96	Watt	1
Inrush Current		$I_{RUSH}$	-	-	5.5	A	2
Permissible Ripple of Power Supply Input Voltage (for input power=12V)		$V_{RP}$	--	--	$V_{DD} * 5\%$	mV <sub>pk-pk</sub>	3
LVDS Interface	Input Differential Voltage	$ V_{ID} $	200	400	600	mV <sub>DC</sub>	4
	Differential Input High Threshold Voltage	$V_{TH}$	+100	--	+300	mV <sub>DC</sub>	4
	Differential Input Low Threshold Voltage	$V_{TL}$	-300	--	-100	mV <sub>DC</sub>	4
	Input Common Mode Voltage	$V_{ICM}$	1.1	1.25	1.4	$V_{DC}$	4
CMOS Interface	Input High Threshold Voltage	$V_{IH}$ (High)	2.7	--	3.3	$V_{DC}$	7
	Input Low Threshold Voltage	$V_{IL}$ (Low)	0	--	0.6	$V_{DC}$	
Backlight Power Consumption		$P_{BL}$	--	123.1		W	
Life Time(MTTF)			--	50000		--	8

### 3.1.2 AC Characteristics

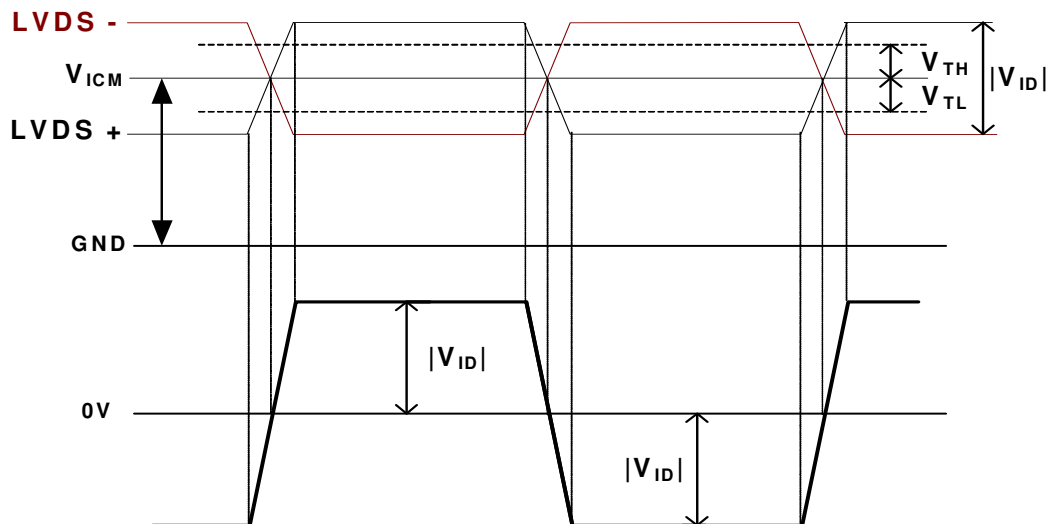
Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max		
LVDS Interface	Receiver Clock : Spread Spectrum Modulation range	Fclk_ss	Fclk -3%	--	Fclk +3%	MHz	9
	Receiver Clock : Spread Spectrum Modulation frequency	Fss	30	--	200	KHz	9
	Receiver Data Input Margin Fclk = 85 MHz Fclk = 65 MHz	tRMG	-0.4 -0.5	-- --	0.4 0.5	ns	10

**Note :**

1. Test Condition:
  - (1)  $V_{DD} = 12.0V$
  - (2)  $F_v$  = Type Timing, 60Hz, 120Hz or Other
  - (3)  $F_{CLK}$  = Max freq.
  - (4) Temperature = 25 °C
  - (5) Test Pattern : White Pattern
2. Measurement condition : Rising time = 400us



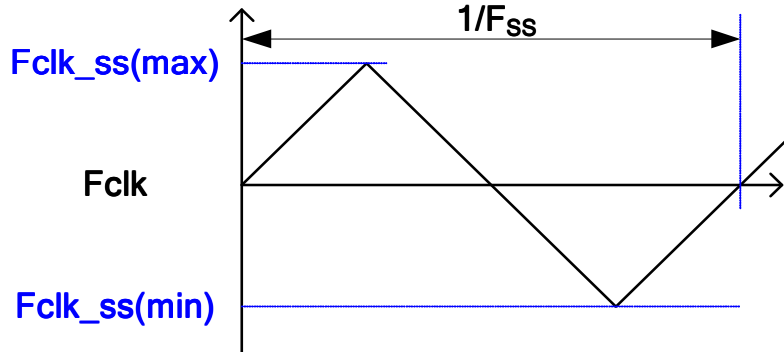
3. Test Condition:
  - (1) The measure point of  $V_{RP}$  is in LCM side after connecting the System Board and LCM.
  - (2) Under Max. Input current spec. condition.
4.  $V_{ICM} = 1.25V$



5. Do not attach a conducting tape to lamp connecting wire. If the lamp wire attach to conducting tape, TFT-LCD Module have a low luminance and the inverter has abnormal action because leakage current occurs between lamp wire and conducting tape.
6. The relative humidity must not exceed 80% non-condensing at temperatures of 40°C or less. At temperatures greater than 40°C, the wet bulb temperature must not exceed 39°C. When operate at low temperatures, the brightness of LED will drop and the life time of LED will be reduced.
7. The measure points of  $V_{IH}$  and  $V_{IL}$  are in LCM side after connecting the System Board and LCM.

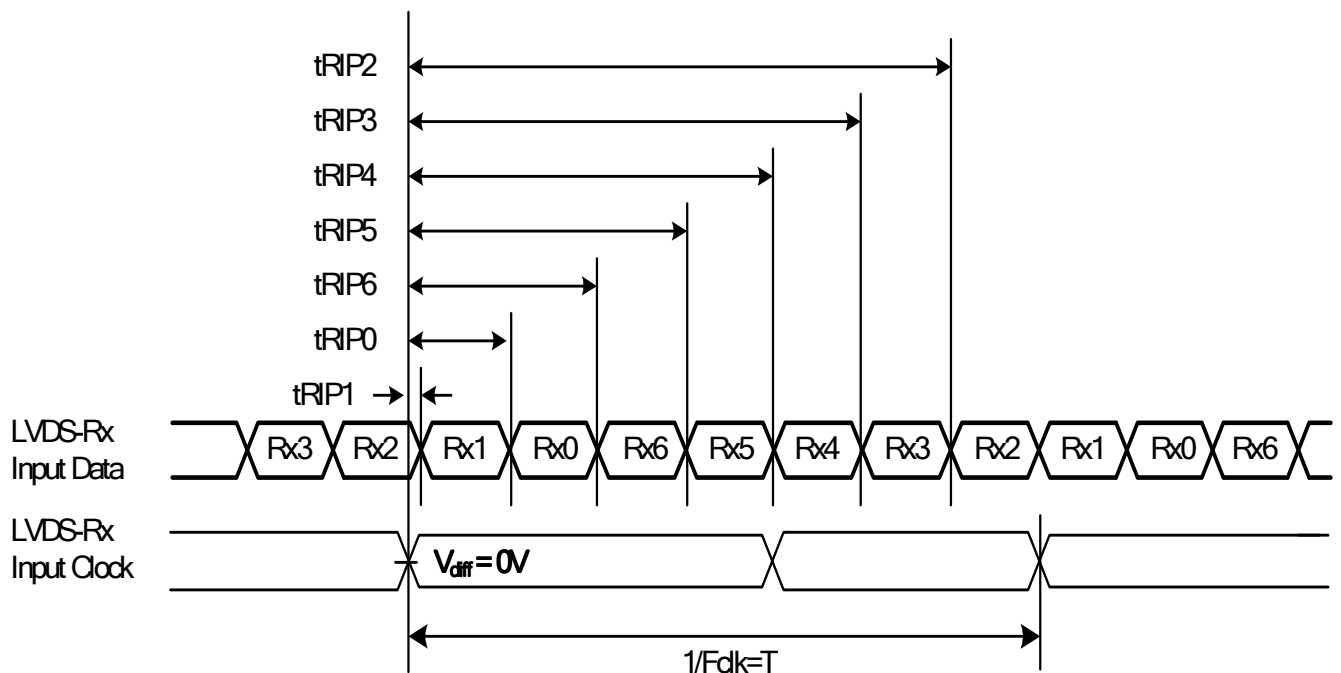
8. The lifetime (MTTF) is defined as the time which luminance of the LED is 50% compared to its original value. [Operating condition: Continuous operating at  $T_a = 25 \pm 2^\circ\text{C}$ , for single lamp/LED only.]

9. LVDS Receiver Clock SSCG (Spread spectrum clock generator) is defined as below figures



10. Receiver Data Input Margin

Parameter	Symbol	Rating			Unit	Note
		Min	Type	Max		
Input Clock Frequency	Fclk	Fclk (min)	--	Fclk (max)	MHz	$T=1/\text{Fclk}$
Input Data Position0	tRIP1	- tRMG	0	tRMG	ns	
Input Data Position1	tRIP0	$T/7 -  tRMG $	$T/7$	$T/7 +  tRMG $	ns	
Input Data Position2	tRIP6	$2T/7 -  tRMG $	$2T/7$	$2T/7 +  tRMG $	ns	
Input Data Position3	tRIP5	$3T/7 -  tRMG $	$3T/7$	$3T/7 +  tRMG $	ns	
Input Data Position4	tRIP4	$4T/7 -  tRMG $	$4T/7$	$4T/7 +  tRMG $	ns	
Input Data Position5	tRIP3	$5T/7 -  tRMG $	$5T/7$	$5T/7 +  tRMG $	ns	
Input Data Position6	tRIP2	$6T/7 -  tRMG $	$6T/7$	$6T/7 +  tRMG $	ns	



### 3.2 Interface Connections

- LCD connector : FI-RE51S-HF (Manufactured by JAE);
- Mating connector: FI-RE51HL (Manufactured by JAE)

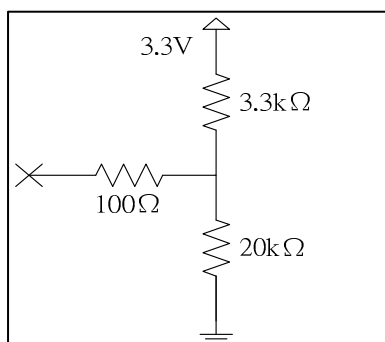
PIN	Symbol	Description	PIN	Symbol	Description
1	VCC	12V Power Supply	27	RXEN1	LVDS Even pixel data input pair 1(-)
2	VCC	12V Power Supply	28	RXEP1	LVDS Even pixel data input pair 1(+)
3	VCC	12V Power Supply	29	RXEN2	LVDS Even pixel data input pair 2(-)
4	VCC	12V Power Supply	30	RXEP2	LVDS Even pixel data input pair 2(+)
5	VCC	12V Power Supply	31	GND	GND
6	GND	GND	32	RXENCLK	LVDS Even pixel clock input pair(-)
7	GND	GND	33	RXEPCLK	LVDS Even pixel clock input pair(+)
8	GND	GND	34	GND	GND
9	GND	GND	35	RXEN3	LVDS Even pixel data input pair 3(-)
10	RXON0	LVDS Odd pixel data input pair 0(-)	36	RXEP3	LVDS Even pixel data input pair 3(+)
11	RXOP0	LVDS Odd pixel data input pair 0(+)	37	RXEN4	LVDS Even pixel data input pair 4(-)
12	RXON1	LVDS Odd pixel data input pair 1(-)	38	RXEP4	LVDS Even pixel data input pair 4(+)
13	RXOP1	LVDS Odd pixel data input pair 1(+)	39	GND	GND
14	RXON2	LVDS Odd pixel data input pair 2(-)	40	NC	No connected
15	RXOP2	LVDS Odd pixel data input pair 2(+)	41	Reserved	AUO Internal Use Only
16	GND	GND	42	NC	No connected
17	RXONCLK	LVDS Odd pixel clock input pair(-)	43	NC	No connected
18	RXOPCLK	LVDS Odd pixel clock input pair(+)	44	NC	No connected
19	GND	GND	45	LVDSORD	Select LVDS data order: High or NC → NS, Low → JEIDA
20	RXON3	LVDS Odd pixel data input pair 3(-)			
21	RXOP3	LVDS Odd pixel data input pair 3(+)	46	NC	No connected
22	RXON4	LVDS Odd pixel data input pair 4(-)	47	NC	No connected
23	RXOP4	LVDS Odd pixel data input pair 4(+)	48	NC	No connected
24	GND	GND	49	Reserved	AUO Internal Use Only
25	RXEN0	LVDS Even pixel data input pair 0(-)	50	Reserved	AUO Internal Use Only
26	RXEP0	LVDS Even pixel data input pair 0(+)	51	Reserved	AUO Internal Use Only

Note 1: All GND (ground) pins should be connected together and should also be connected to the LCD's metal frame.

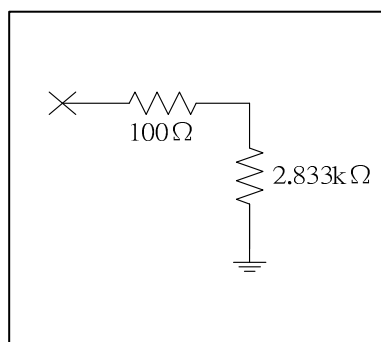
Note 2: All  $V_{DD}$  (power input) pins should be connected together.

Note 3: All NC (no connection) pins should be open without voltage input.

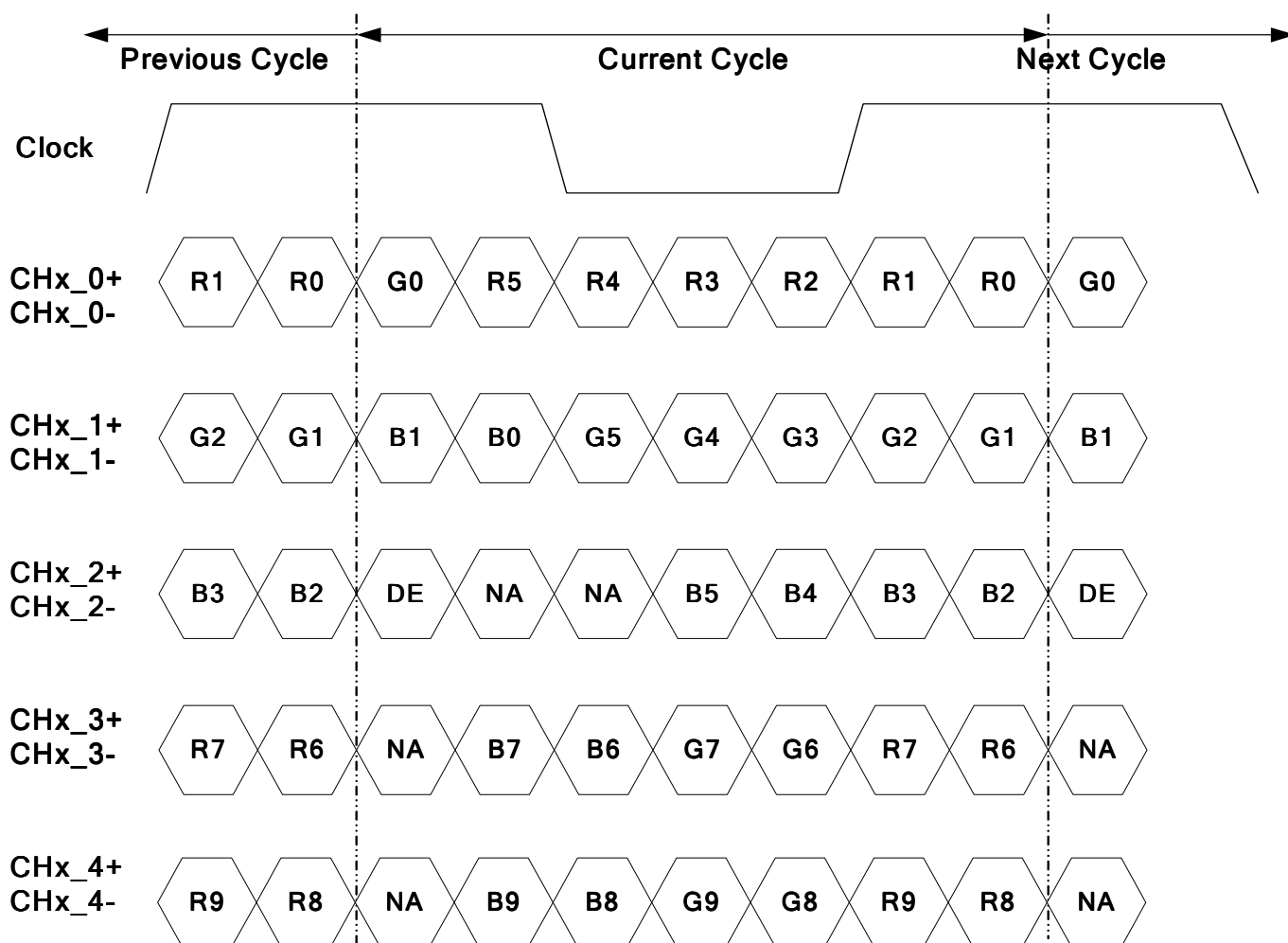
**Note \* : Open/High(3.3V)**



**Note \*\* : Open/Low(GND)**

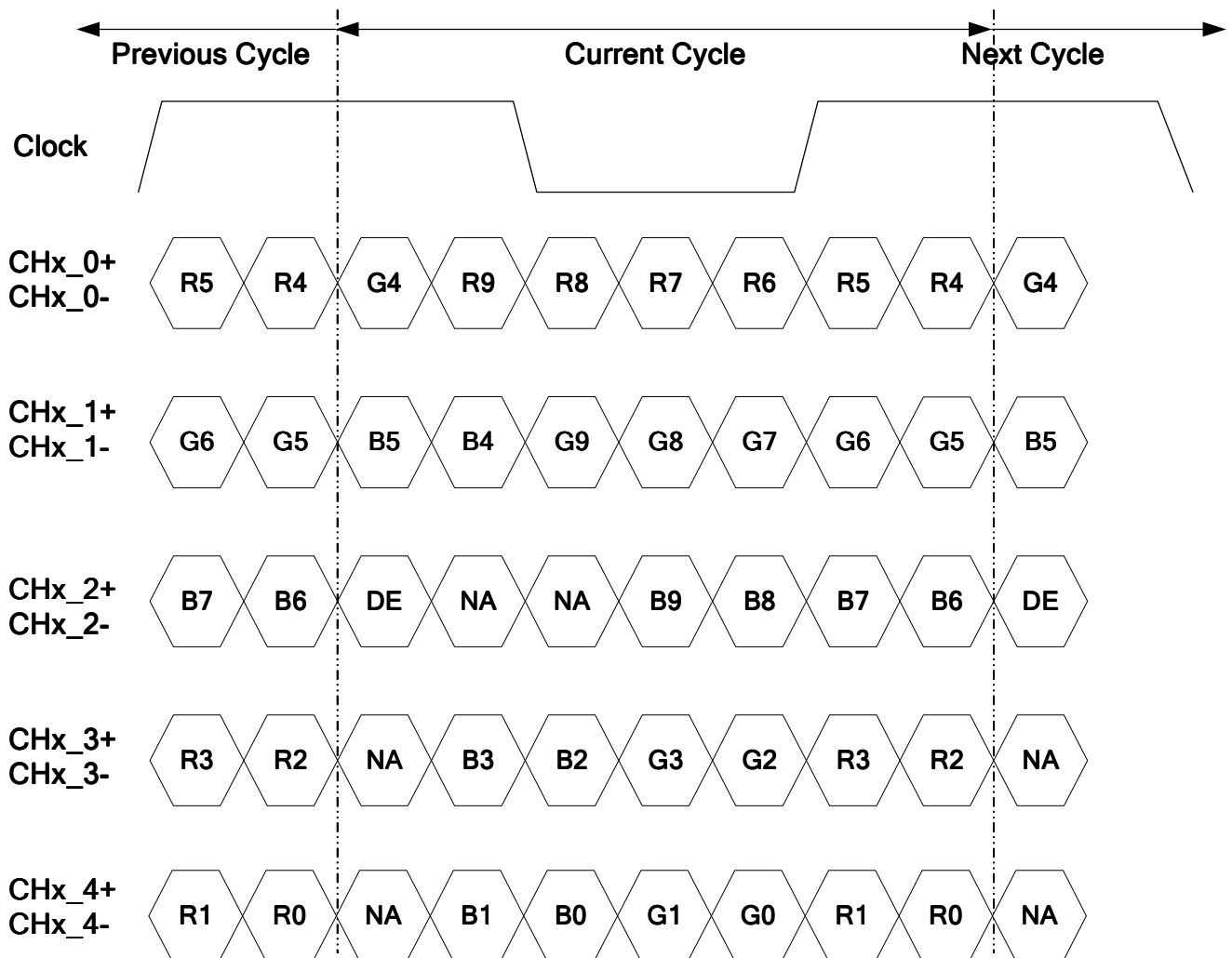


LVDS Option = High/Open → NS



Note: x = 1, 2, 3, 4...

LVDS Option = Low → JEIDA



Note: x = 1, 2, 3, 4...

### 3.3 Signal Timing Specification

This is the signal timing required at the input of the user connector. All of the interface signal timing should be satisfied with the following specifications for its proper operation.

#### Timing Table (DE only Mode)

##### Vertical Frequency Range (60Hz)

Signal	Item	Symbol	Min.	Typ.	Max	Unit
Vertical Section	Period	Tv	1090	1125	1480	Th
	Active	Tdisp (v)	1080			Th
	Blanking	Tblk (v)	10	45	400	Th
Horizontal Section	Period	Th	1030	1100	1325	Tclk
	Active	Tdisp (h)	960			Tclk
	Blanking	Tblk (h)	70	140	365	Tclk
Clock	Frequency	Fclk=1/Tclk	50	74.25	82	MHz
Vertical Frequency	Frequency	Fv	47	60	63	Hz
Horizontal Frequency	Frequency	Fh	60	67.5	73	KHz

Notes:

(1) Display position is specific by the rise of DE signal only.

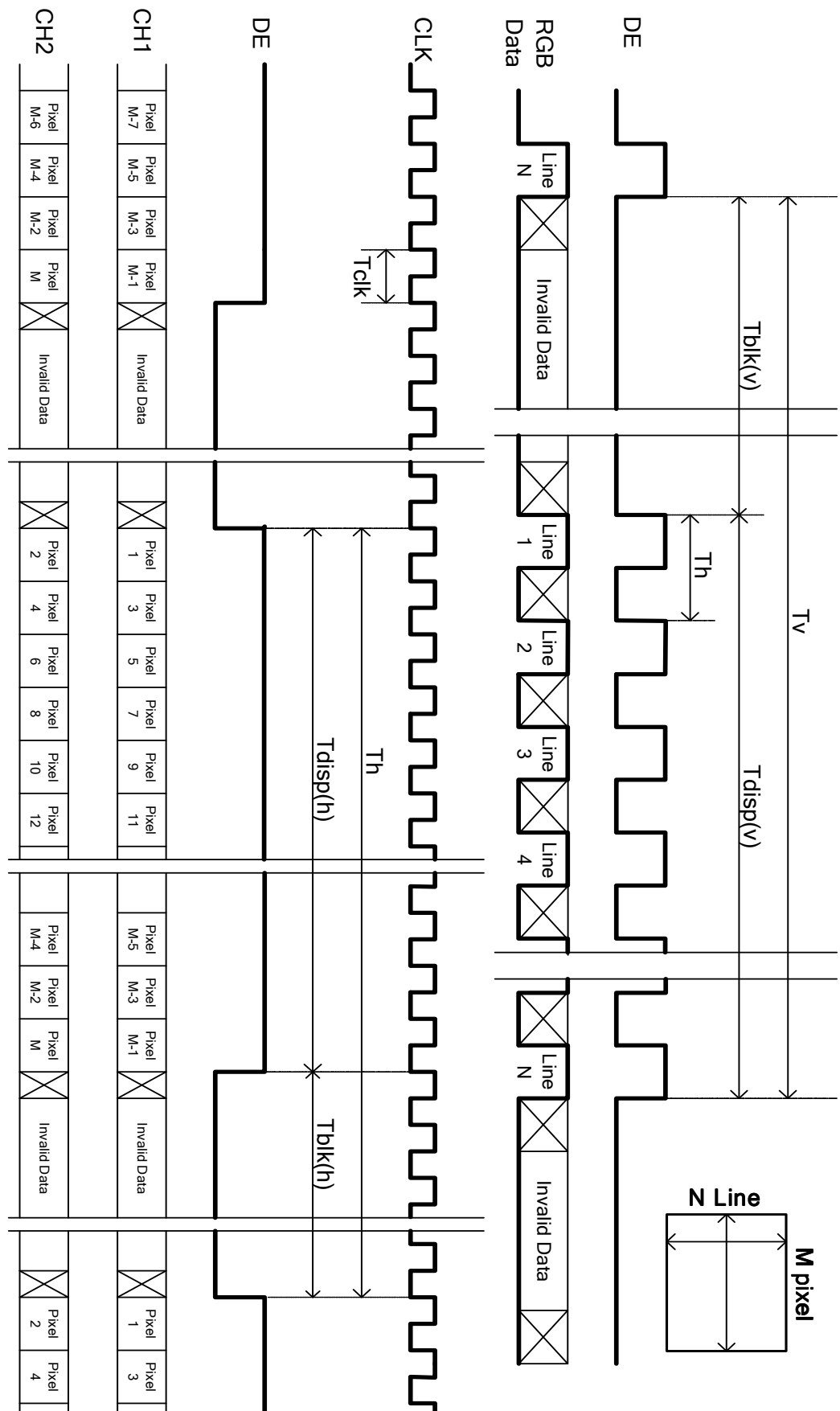
Horizontal display position is specified by the rising edge of 1<sup>st</sup> DCLK after the rise of 1<sup>st</sup> DE, is displayed on the left edge of the screen.

(2) Vertical display position is specified by the rise of DE after a "Low" level period equivalent to eight times of horizontal period. The 1<sup>st</sup> data corresponding to one horizontal line after the rise of 1<sup>st</sup> DE is displayed at the top line of screen.

(3) If a period of DE "High" is less than 1920 DCLK or less than 1080 lines, the rest of the screen displays black.

(4) The display position does not fit to the screen if a period of DE "High" and the effective data period do not synchronize with each other.

### 3.4 Signal Timing Waveforms



### 3.5 Color Input Data Reference

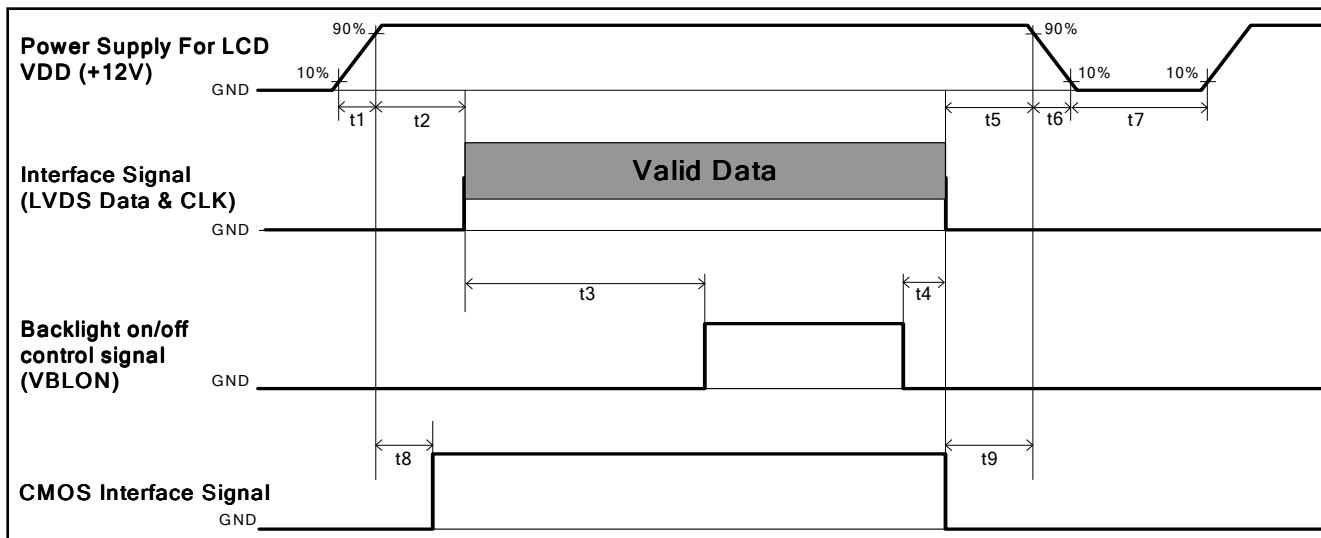
The brightness of each primary color (red, green and blue) is based on the 10 bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

COLOR DATA REFERENCE

Color		Input Color Data																															
		RED										GREEN										BLUE											
		MSB					LSB					MSB					LSB					MSB						LSB					
		R9	R8	R7	R6	R5	R4	R3	R2	R1	R0	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0		
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Red(1023)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Green(1023)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0		
	Blue(1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1		
	Cyan	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
	Magenta	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1		
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0		
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
R	RED(000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	RED(001)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	----																																
	RED(1022)	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	RED(1023)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
G	GREEN(000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	GREEN(001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0		
	----																																
	GREEN(1022)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0		
	GREEN(1023)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0		
B	BLUE(000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	BLUE(001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		
	----																																
	BLUE(1022)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0		
	BLUE(1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1		

### 3.6 Power Sequence

#### ◆ Power Sequence of LCD



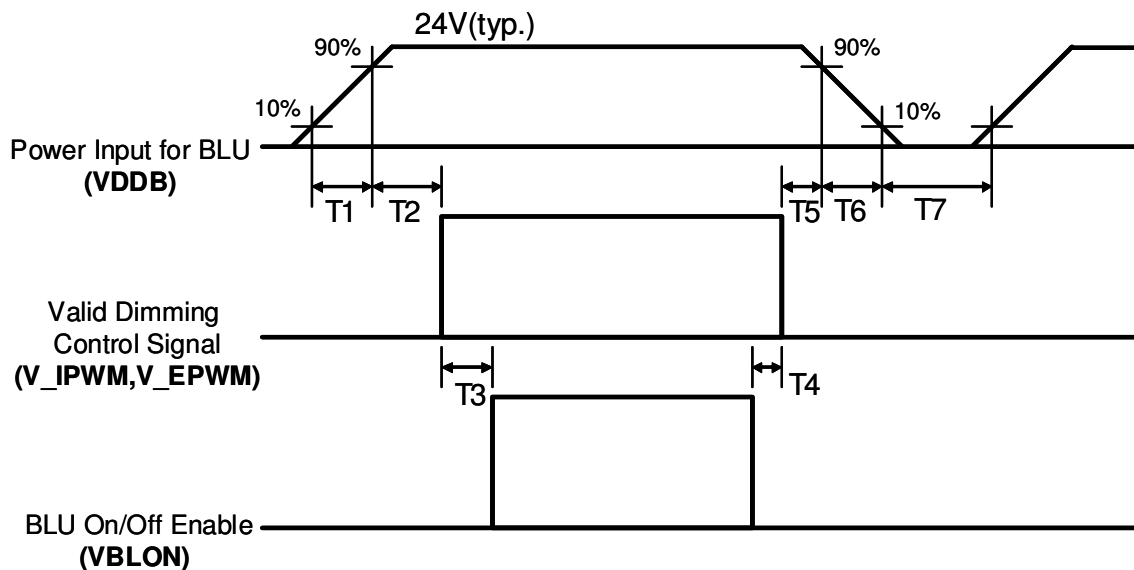
Parameter	Values			Unit
	Min.	Type.	Max.	
t1	0.4	---	30	ms
t2	0.1	---	50	ms
t3	450	---	---	ms
t4	0 <sup>*1</sup>	---	---	ms
t5	0	---	---	ms
t6	---	---	--- <sup>*2</sup>	ms
t7	500	---	---	ms
t8	10	---	50	ms
t9	0	---	---	ms

Note:

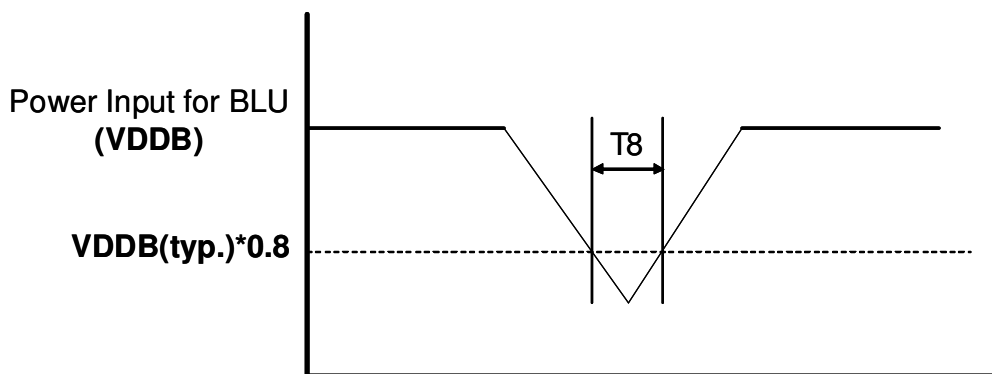
(1) t4=0 : concern for residual pattern before BLU turn off.

(2) t6 : voltage of VDD must decay smoothly after power-off. (customer system decide this value)

◆ Power Sequence of Backlight



Dip condition



Parameter	Value			Units
	Min	Typ	Max	
T1	20	-	-	ms <sup>*1</sup>
T2	500	-	-	ms
T3	250	-	-	ms
T4	0	-	-	ms
T5	1	-	-	ms
T6		-	-	ms
T8	-	-	10	ms

### 3.7 Backlight Specification

The backlight unit contains 120pcs LED.

#### 3.7.1 Electrical specification

	Item	Symbol		Condition	Spec			Unit	Note
					Min	Typ	Max		
1	Input Voltage	VDDB		-	21.6	24	26.4	VDC	-
2	Input Current	I <sub>DDB</sub>		VDDB=24V	--	5.13	5.4	ADC	1
3	Input Power	P <sub>DDB</sub>		VDDB=24V	--	123.1	129.5	W	1
4	Inrush Current	I <sub>RUSH</sub>		VDDB=24V	-	-	12.24	ADC	2
5	On/Off control voltage	V <sub>BLOn</sub>	ON	VDDB=24V	2	-	5.5	VDC	-
			OFF		0	-	0.8		-
6	On/Off control current	I <sub>BLOn</sub>		VDDB=24V	-	-	1.5	mA	-
7	External PWM Control Voltage	V <sub>EPWM</sub>	MAX	VDDB=24V	2	-	3.3	VDC	-
			MIN	VDDB=24V	0	-	0.8		-
8	External PWM Control Current	I <sub>EPWM</sub>		VDDB=24V	-	-	2	mADC	-
9	External PWM Duty ratio	D <sub>EPWM</sub>		VDDB=24V	5	-	100	%	3
10	External PWM Frequency	F <sub>EPWM</sub>		VDDB=24V	140	180	240	Hz	-
11	DET status signal	DET	HI	VDDB=24V	Open Collector			VDC	-
			LO		0	-	0.8	VDC	-
12	Input Impedance	R <sub>in</sub>		VDDB=24V	300			Kohm	-

Note 1 : Dimming ratio= 100% (MAX) ( Ta=25±5℃ , Turn on for 45minutes )

Note 2: Measurement condition Rising time = 20ms (VDDB : 10%~90%) and at dimming ration = 100%

Note 3: Less than10% dimming control is functional well and no backlight shutdown happened

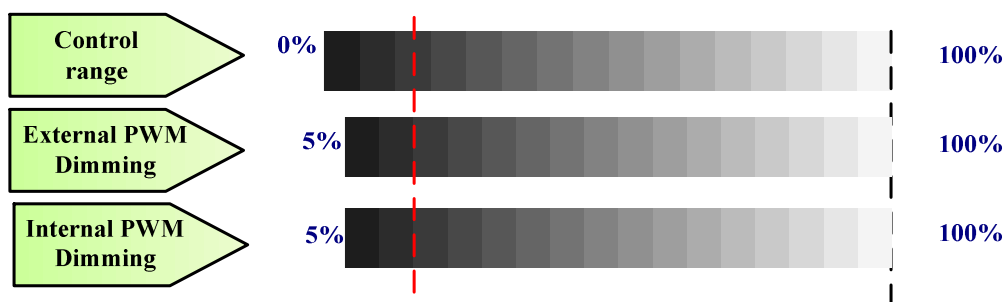
### 3.7.2 Input Pin Assignment

- LED driver board connector: CI0114M1HR0-NH (Cvilux)

Pin	Symbol	Description
1	VDDDB	Operating Voltage Supply, +24V DC regulated
2	VDDDB	Operating Voltage Supply, +24V DC regulated
3	VDDDB	Operating Voltage Supply, +24V DC regulated
4	VDDDB	Operating Voltage Supply, +24V DC regulated
5	VDDDB	Operating Voltage Supply, +24V DC regulated
6	BLGND	Ground and Current Return
7	BLGND	Ground and Current Return
8	BLGND	Ground and Current Return
9	BLGND	Ground and Current Return
10	BLGND	Ground and Current Return
11	DET	BLU status detection: Normal : 0~0.8V ; Abnormal : Open collector
12	VBLOn	BLU On-Off control: BL On : High/Open (2V~5.5V); BL off : Low (0~0.8V/GND)
13	VDIM	NA
14	PDIM	External PWM (5%~100% Duty, open for 100%) < NC ; at Internal PWM mode>

- LED driver board connector: CI0112M1HR0-NH(Cvilux)

Pin	Symbol	Description
1	VDDDB	Operating Voltage Supply, +24V DC regulated
2	VDDDB	Operating Voltage Supply, +24V DC regulated
3	VDDDB	Operating Voltage Supply, +24V DC regulated
4	VDDDB	Operating Voltage Supply, +24V DC regulated
5	VDDDB	Operating Voltage Supply, +24V DC regulated
6	BLGND	Ground and Current Return
7	BLGND	Ground and Current Return
8	BLGND	Ground and Current Return
9	BLGND	Ground and Current Return
10	BLGND	Ground and Current Return
11	NC	No connection
12	NC	No connection



PWM Dimming : include Internal and External PWM Dimming

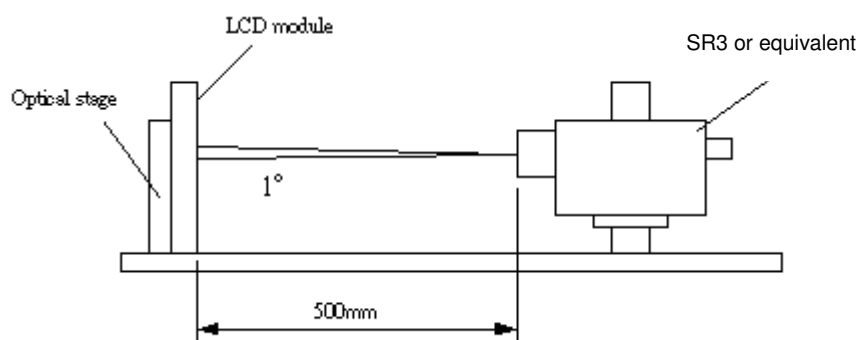
(Note\*) IF External PWM function includes 5% dimming ratio. Judge condition as below:

- (1) Backlight module must be lighted ON normally.
- (2) All protection function must work normally.
- (3) Uniformity and flicker could NOT be guaranteed

## 4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 45 minutes in a dark environment at 25°C while panel is placed in the default position. The default position is T-con side as the top side of panel. The value specified is at an approximate distance 50cm from the LCD surface at a viewing angle of  $\varphi$  and  $\theta$  equal to 0°.

**Fig.1 presents additional information concerning the measurement equipment and method.**



Parameter		Symbol	Values			Unit	Notes
			Min.	Typ.	Max		
Contrast Ratio		CR	3200	4000	--		1
Surface Luminance (White)		$L_{WH}$	560	700	--	cd/m <sup>2</sup>	2
Luminance Variation		$\delta_{WHITE(9P)}$	--	--	1.33		3
Response Time (G to G)		$T_y$	--	6.5	--	ms	4
Color Gamut		NTSC		72		%	
Color Coordinates							
	Red	$R_x$	Typ.-0.03	0.640	Typ.+0.03		
		$R_y$		0.330			
	Green	$G_x$		0.300			
		$G_y$		0.605			
	Blue	$B_x$		0.150			
		$B_y$		0.050			
	White	$W_x$		0.280			
		$W_y$		0.290			
Viewing Angle							5
	x axis, right( $\varphi=0^\circ$ )	$\theta_r$	--	89	--	degree	
	x axis, left( $\varphi=180^\circ$ )	$\theta_l$	--	89	--	degree	
	y axis, up( $\varphi=90^\circ$ )	$\theta_u$	--	89	--	degree	
	y axis, down ( $\varphi=270^\circ$ )	$\theta_d$	--	89	--	degree	

Note:

1. Contrast Ratio (CR) is defined mathematically as:

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance of } L_{\text{on5}}}{\text{Surface Luminance of } L_{\text{off5}}}$$

2. Surface luminance is luminance value at point 5 across the LCD surface 50cm from the surface with all pixels displaying white. From more information see FIG 2. LED current  $I_F$  = typical value (without driver board), LED input  $V_{\text{DDB}} = 24\text{V}$ ,  $I_{\text{DDB}}$  = Typical value (with driver board),  $L_{\text{WH}} = L_{\text{on5}}$  where  $L_{\text{on5}}$  is the luminance with all pixels displaying white at center 5 location.

3. The variation in surface luminance,  $\delta\text{WHITE}$  is defined (center of Screen) as:

$$\delta\text{WHITE(9P)} = \frac{\text{Maximum}(L_{\text{on1}}, L_{\text{on2}}, \dots, L_{\text{on9}})}{\text{Minimum}(L_{\text{on1}}, L_{\text{on2}}, \dots, L_{\text{on9}})}$$

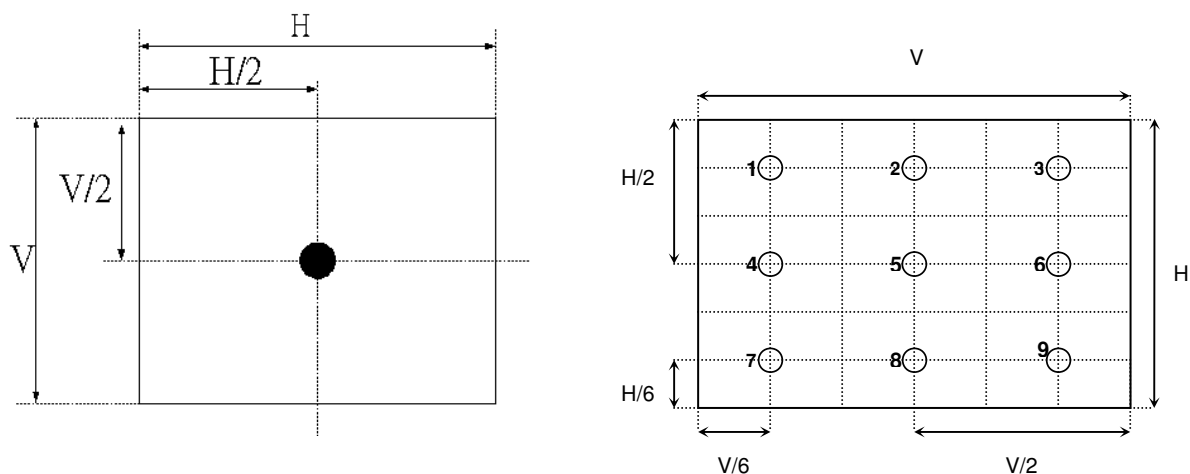
4. Response time  $T_\gamma$  is the average time required for display transition by switching the input signal for five luminance ratio (0%, 25%, 50%, 75%, 100% brightness matrix) and is based on  $F_v = 60\text{Hz}$  to optimize.

Measured Response Time		Target				
		0%	25%	50%	75%	100%
Start	0%		0% to 25%	0% to 50%	0% to 75%	0% to 100%
	25%	25% to 0%		25% to 50%	25% to 75%	25% to 100%
	50%	50% to 0%	50% to 25%		50% to 75%	50% to 100%
	75%	75% to 0%	75% to 25%	75% to 50%		75% to 100%
	100%	100% to 0%	100% to 25%	100% to 50%	100% to 75%	

$T_\gamma$  is determined by 10% to 90% brightness difference of rising or falling period. (As illustrated)

The response time is defined as the following figure and shall be measured by switching the input signal for “any level of gray(bright)” and “any level of gray(dark)”.

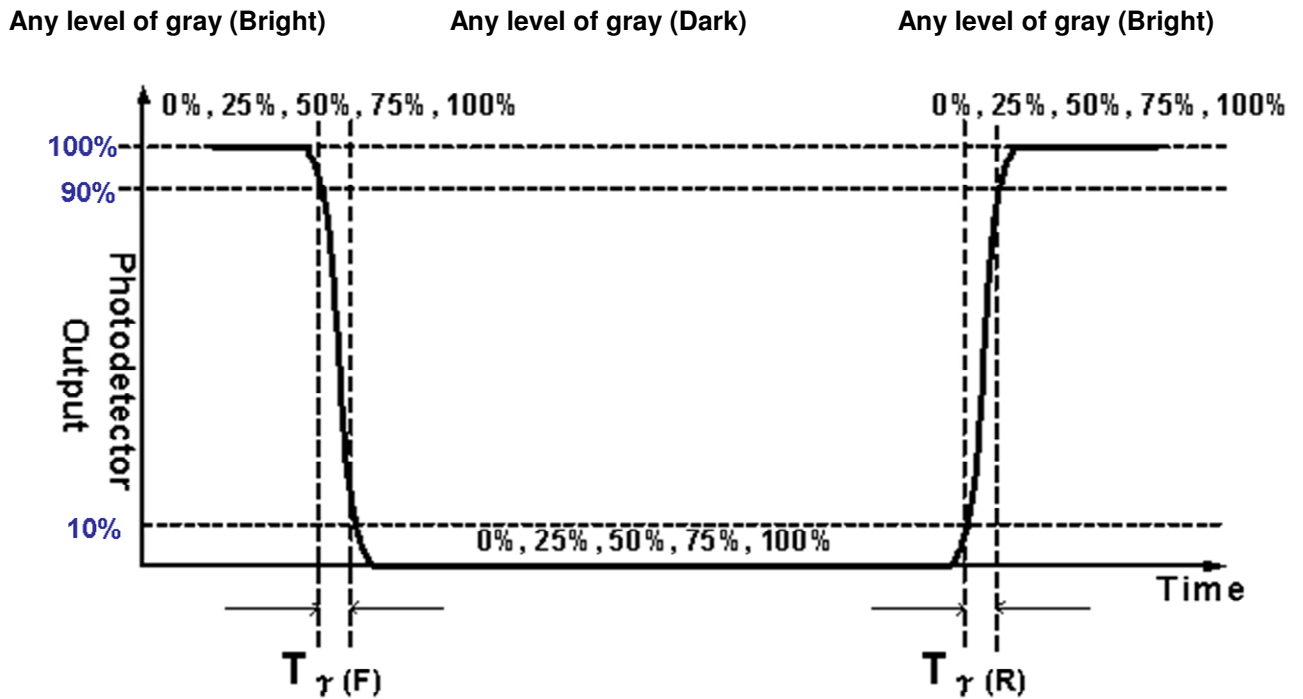
**FIG. 2 Luminance**



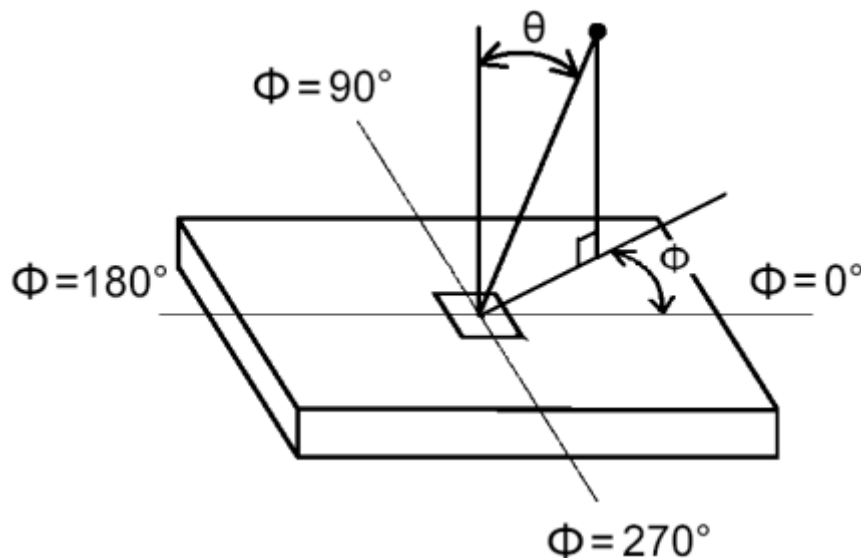
5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG4.

**FIG.3 Response Time**

The response time is defined as the following figure and shall be measured by switching the input signal for “any level of gray(bright) “ and “any level of gray(dark)”.



**FIG.4 Viewing Angle**



## 5. Mechanical Characteristics

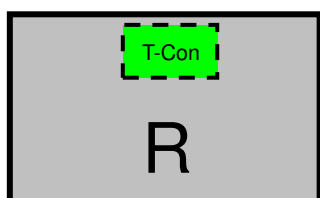
The contents provide general mechanical characteristics for the model P460HVN01.2. In addition the figures in the next page are detailed mechanical drawing of the LCD.

Item		Dimension	Unit	Note
Outline Dimension	Horizontal	1023.68	mm	
	Vertical	578.27	mm	
	Depth (Dmin)	37.5	mm	to rear
	Depth (Dmax)	54.2	mm	to DB cover
Weight	13500g		g	

### 5.1 Placement suggestions:

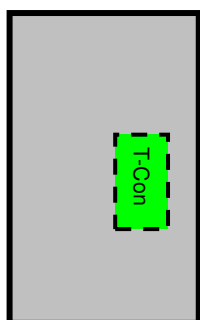
1. Landscape Mode: The default placement is T-Con Side on the top side and the image is shown **upright** via viewing from the front.

Landscape (Front view)

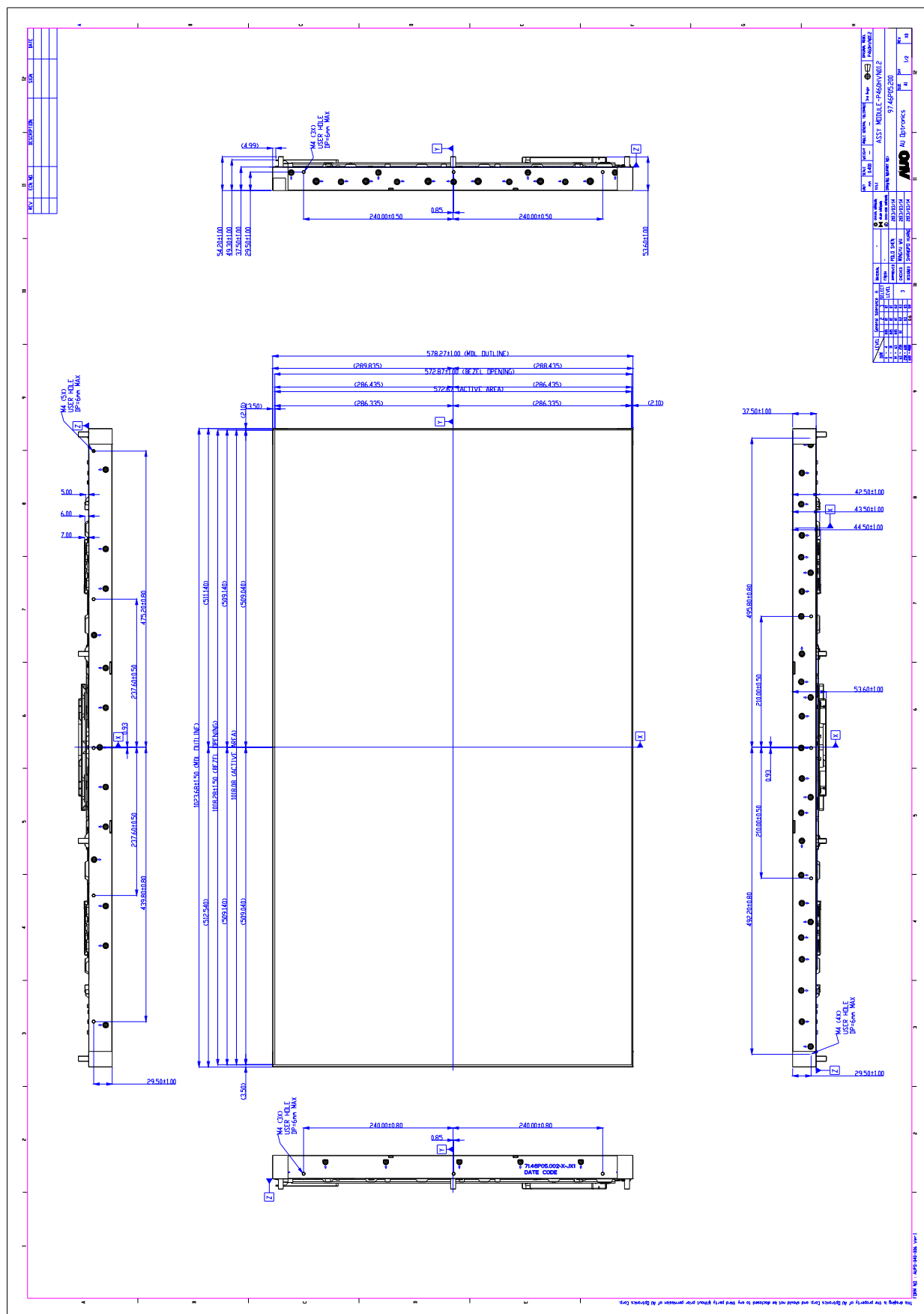


2. Portrait Mode: The default placement is that T-Con side has to be placed on the right side via viewing from the front.

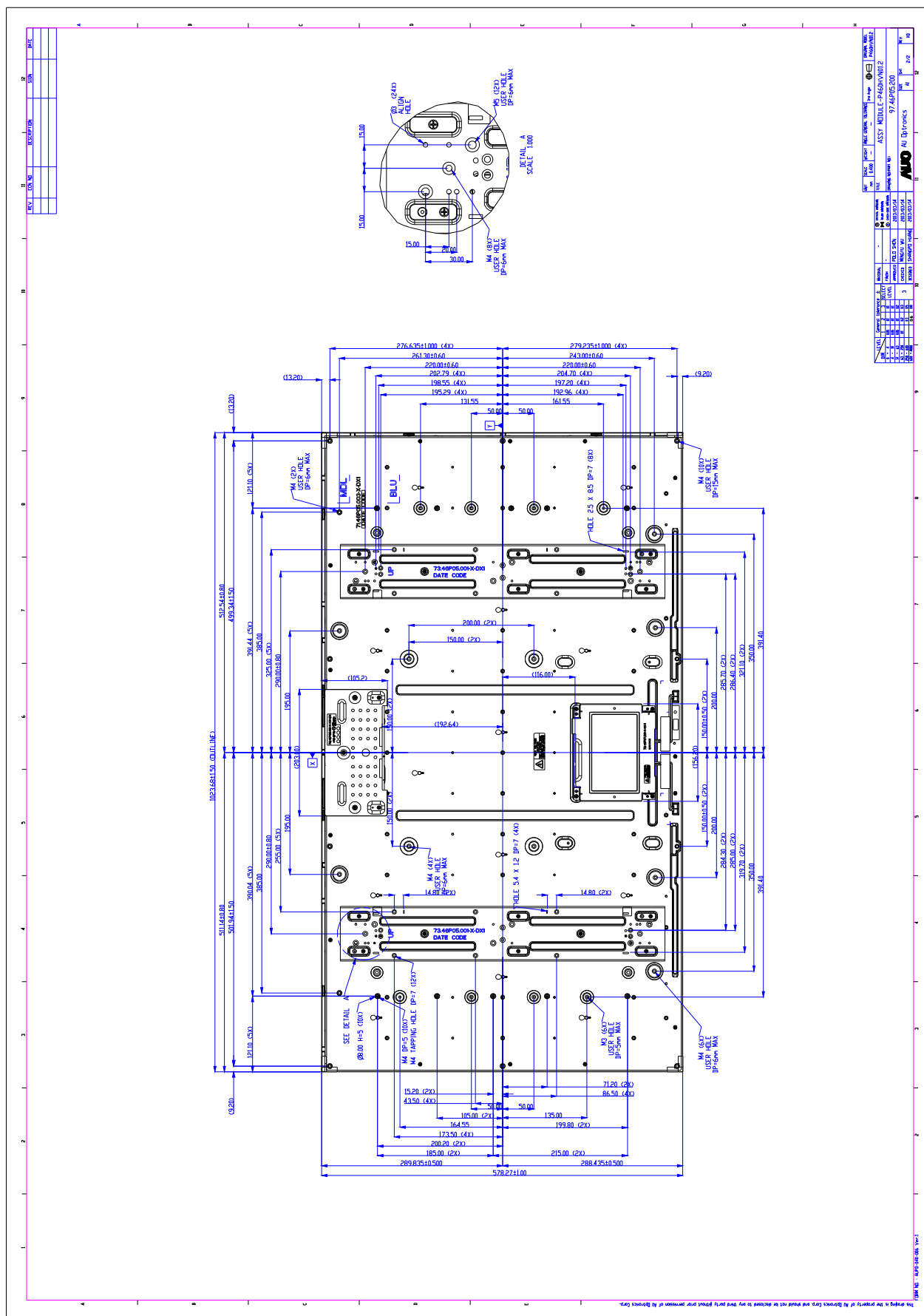
Portrait (Front view)



### Front View



## Back View



## 6. Reliability Test Items

	Test Item	Q'ty	Condition
1	High temperature storage test	3	60°C , 500hrs
2	Low temperature storage test	3	-20°C , 500hrs
3	High temperature operation test	3	50°C , 500hrs
4	Low temperature operation test	3	-5°C , 500hrs
5	Vibration test (non-operation)	3	Wave form: random Vibration level: 0.5G RMS Bandwidth: 10-300Hz, Duration: X, Y, Z 30min per axes
6	Shock test (non-operation)	3	Shock level: 10G Waveform: half sine wave, 11ms Direction: $\pm X$ , $\pm Y$ , $\pm Z$ , One time each direction
7	Vibration test (With carton)	1 (PKG)	Random wave (1.05G RMS, 10-200Hz) 10mins per each X,Y,Z axes
8	Drop test (With carton)	1 (PKG)	Drop Height: 17.8 cm, Surround four flats and bottom flat twice. (ASTMD4169-I)

## 7. International Standard

### 7.1 Safety

(1) UL60950-1, 2<sup>nd</sup> Ed., Underwriters Laboratories, (AUO file number: E204356)

Standard for safety of information technology equipment including electrical business equipment

(2) IEC 60950-1

(3) EN60950-1

European Committee for Electro technical Standardization (CENELEC)

European Standard for safety of information technology equipment including electrical business equipment

### 7.2 EMC

(1) ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHz to 40GHz. "American National standards Institute(ANSI), 1992

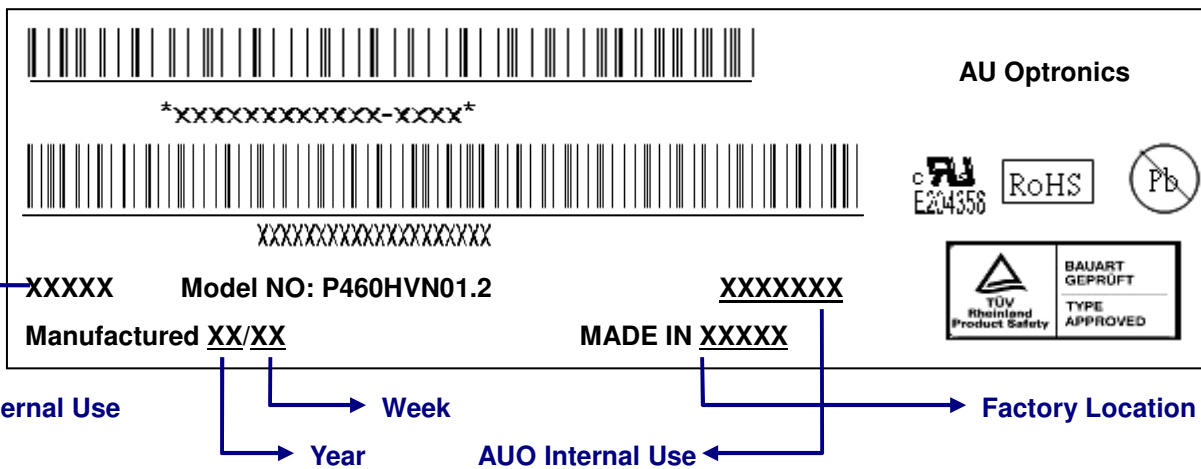
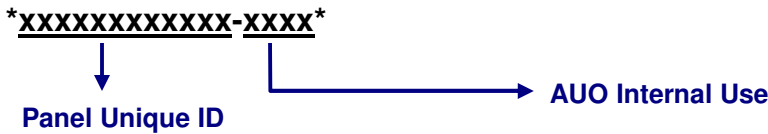
(2) C.I.S.P.R "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." International Special committee on Radio Interference.

(3) EN 55022 "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." European Committee for Electro technical Standardization. (CENELEC), 1998

## 8. Packing

### 8-1 DEFINITION OF LABEL:

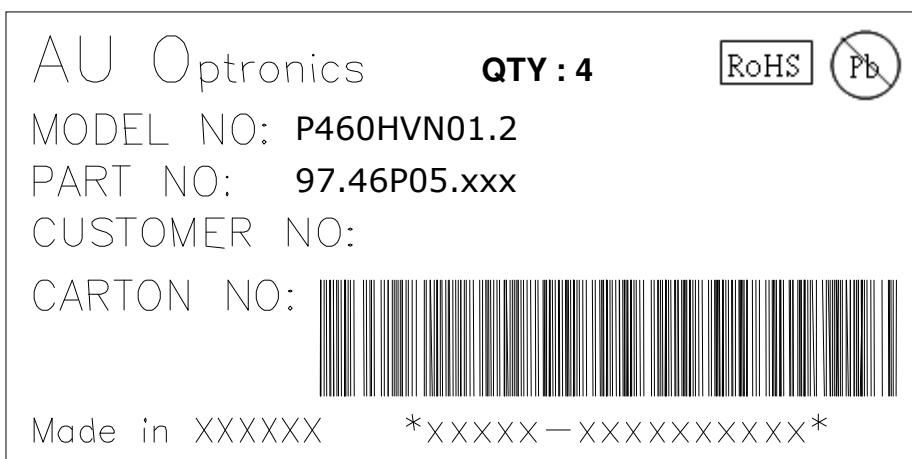
#### A. Panel Label:



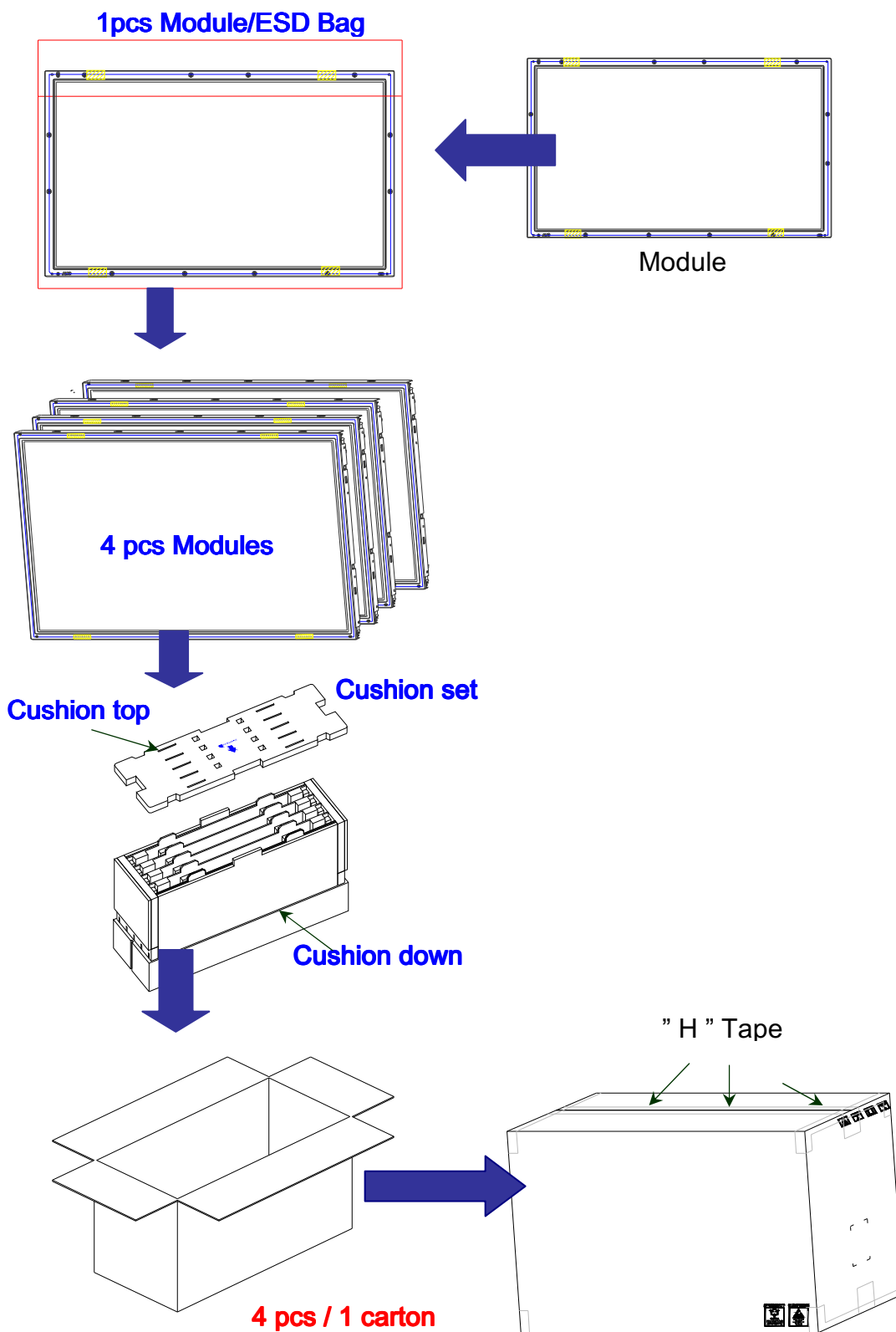
#### Green mark description

- (1) For Pb Free Product, AUO will add for identification.
  - (2) For RoHS compatible products, AUO will add for identification.
- Note: The green Mark will be present only when the green documents have been ready by AUO internal green team. (definition of green design follows the AUO green design checklist.)

#### B. Carton Label: (TBD)

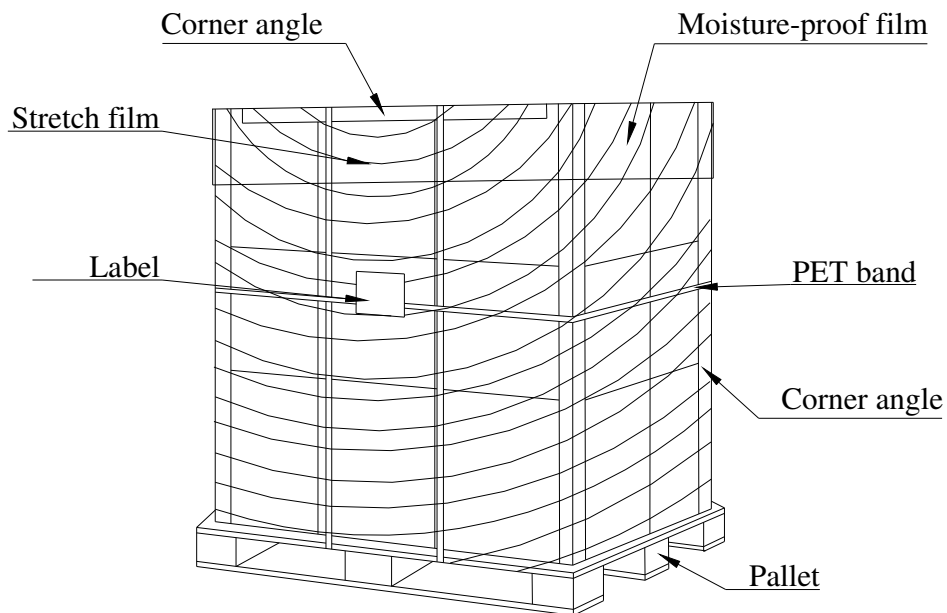


## 8-2 PACKING METHODS:



### 8-3 Pallet and Shipment Information

	Item	Specification			Packing Remark
		Qty.	Dimension	Weight (kg)	
1	Packing Box	4pcs/box	1160(L)mm*375(W)mm*690(H)mm	61	
2	Pallet	1	1180(L)mm*1150(W)mm*132(H)mm	18	
3	Boxes per Pallet	3 boxes/Pallet (By Air) ; 3 Boxes/Pallet (By Sea)			
4	Panels per Pallet	12pcs/pallet(By Air) ; 12pcs/Pallet (By Sea)			
5	Pallet after packing	12(by Air)	1180(L)mm*1150(W)mm*822(H)mm (by Air)	201 (by Air)	
		36(by Sea)	1180(L)mm*1150(W)mm*2466(H)mm (by Sea)	603 (by Sea)	40ft HQ



## 9. PRECAUTIONS

Please pay attention to the followings when you use this TFT LCD module.

### 9-1 MOUNTING PRECAUTIONS

- (1) You must mount a module using holes arranged in four corners or four sides.
- (2) You should consider the mounting structure so that uneven force (ex. twisted stress) is not applied to module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to resist external force.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter cause circuit broken by electro-chemical reaction.
- (6) Do not touch, push or rub the exposed polarizer with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth. (Some cosmetics are detrimental to the polarizer.)
- (7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front/ rear polarizer. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- (8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (9) Do not open the case because inside circuits do not have sufficient strength.

### 9-2 OPERATING PRECAUTIONS

- (1) The device listed in the product specification sheets was designed and manufactured for public information display application.
- (2) The spike noise causes the mis-operation of circuits. It should be lower than following voltage:  
 $V = \pm 200\text{mV}$  (Over and under shoot voltage)
- (3) Response time depends on the temperature. (In lower temperature, it becomes longer..)
- (4) Brightness of LED depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.
- (5) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- (6) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (7) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall

be done by system manufacturers. Grounding and shielding methods may be important to minimize the interface.

### **9-3 ELECTROSTATIC DISCHARGE CONTROL**

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wristband etc. And don't touch interface pin directly.

### **9-4 PRECAUTIONS FOR STRONG LIGHT EXPOSURE**

Strong light exposure causes degradation of polarizer and color filter.

### **9-5 STORAGE**

When storing modules as spares for a long time, the following precautions are necessary.

- (1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- (2) The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

### **9-6 HANDLING PRECAUTIONS FOR PROTECTION FILM**

- (1) The protection film is attached to the bezel with a small masking tape. When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- (2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.
- (3) You can remove the glue easily. When the glue remains on the bezel or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

### **9-7 Operating Condition in PID Application**

- (1) If the continuous static display is required, periodically inserting a motion picture is strongly recommended.
- (2) Recommend to periodically change the background color and background image.
- (3) Recommend not to continuously operate over 18 hours a day.
- (4) Recommend to adopt one of the following actions after long time display.
  - I. Running the screen saver (motion picture or black pattern)
  - II. Power off the system for a while
- (5) Try not to run the LCD in a closed environment. Suitable venting on the system cover would be helpful for cooling.
- (6) It is better to adapt active cooling with fans for long time displaying, especially for high luminance LCD model.